NEW DATES AND DATA ON EARLY AGRICULTURE: THE LEGACY OF COMPLEX HUNTER-GATHERERS[1]

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ABSTRACT

The Accelerator Mass Spectrometry (AMS) method of radiocarbon dating has shortened the history of maize agriculture by demonstrating that purported earliest cobs from Mexico, New Mexico, and eastern North America are younger than, and intrusive into, earlier archaeological strata. Models of agricultural origins based on a 5000 B.C. or earlier date for cultigens must be discarded or validated by directly dated specimens. A more recent date (ca. 3000–3500 B.C.) for maize domestication leads to a new focus on settled hunter-gatherers in resource-rich zones. Social complexity in nonagricultural societies elsewhere is becoming more generally appreciated. In the Lower Mississippi Valley, nonagricultural mound builders persisted until 1100 A.D., and in Florida, California, and the Pacific Northwest, stratified hunter-gatherers flourished until Europeans arrived. These examples of sustainable harvesting demonstrate the long-term viability of such systems.

In much of the Western Hemisphere, we can no longer state that agriculture began as long ago as outlined in many currently used textbooks. Examples include the sequence for maize domestication in Mexico and the spread of maize to the Greater Southwest and the region that is now the eastern United States. The standard scenarios, even though they have been undermined by new dates and new data, have a strong hold on professionals and informed members of the general public. Maybe people think it will be only a few years until new discoveries are made that push back the chronology to its prior position if not farther. Maybe we cling to the old models out of respect for our pioneering mentors. Whatever forces are operating, it is time to go public with the new, younger dates and to accept the damage to cherished scenarios.

I begin this paper by evaluating the impact of the Accelerator Mass Spectrometer (AMS) method of radiocarbon dating on the study of agricultural evolution in the New World. I then turn to evidence generated by another technological innovation—archaeological flotation—and summarize the unexpected results of archaeobotanical studies in the Midwestern United States and the Lower Mississippi Valley. Nonagricultural societies persisted longer than previously believed in both Mexico and the Lower Mississippi Valley. In Louisiana, dense populations of sedentary and socially complex mound builders preceded the adoption of maize. This leads to a discussion of complex fisher-gatherer-hunters in general, because groups in the Lower Mississippi Valley seem similar in many ways to other sedentary, nonagricultural peoples, including the Natufians and Epipaleolithic villagers of the ancient Near East, the Calusa of Florida, and native American groups in California and the coastal Pacific Northwest. The western North American groups practiced what seems to qualify as sustainable harvesting quite successfully for millennia, until the European incursion, supporting population densities exceeding those of all farming societies north of Mesoamerica.

I believe we can apply this knowledge to discussions of modern resource management and ecological imbalance, and I conclude this paper by emphasizing the viability of sustainable harvesting when it is put in long-term perspective.

NEW DATES ON "EARLY" MAIZE

THE AMS RADIOCARBON METHOD AND ITS IMPACT

Radiocarbon dating has been an essential tool for archaeologists since Willard Libby offered it to scientists in 1949 (Taylor, 1987). Many techno-

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TABLE 1. AMS radiocarbon dates on maize cobs from Coxcatlán and San Marcos caves, Tehuacán Valley, Mexico (from Long et al., 1989).

C-14 age (years B.P.)	Uncalibrated midpoint	Calibrated range (1-sigma)
450 ± 40	A.D. 1500	A.D. 1400–1460
1560 ± 50	A.D. 390	A.D. 440–620
1860 ± 45	A.D. 90	A.D. 80–220
1900 ± 60	A.D. 50	A.D. 20–200
3740 ± 60	1790 B.C.	2280–2040 B.C.
4040 ± 100	2090 B.C.	2580–2500 B.C.
4090 ± 50	2140 B.C.	2870–2580 B.C.
4150 ± 50	2200 B.C.	2880–2660 B.C.
4600 ± 60	2650 B.C.	3380–3360 B.C.
4680 ± 50	2730 B.C.	3500–3380 B.C.
4700 ± 60	2750 B.C.	3500–3380 B.C.
4700 ± 110	2750 B.C.	3640–3360 B.C.

logical improvements have been made during the last 45 years. The innovation that concerns us most is the AMS method, which enables very small samples to be assayed. Laboratories request 5–10 grams of organic material for a standard age determination, but that much charcoal or other organic matter in tight archaeological context is difficult to find in many sites. Radiocarbon dating is a destructive method: the object submitted is converted to gas or liquid benzene solution. For many decades, therefore, valuable samples such as early corn cobs could not be sacrificed and had to be considered the same age as associated wood charcoal or other organic material.

The AMS method, however, requires only a few milligrams of organic matter, so that individual seeds or very small pieces of larger items can be directly dated (Hedges & Gowlett, 1986). The reason that, in some regions, the earliest evidence for certain crops has become younger is that many specimens recently subjected to AMS radiocarbon dating turned out to be intrusive into the older strata in which they were encountered. This is especially common in caves and rockshelters, where slabs fall from the roof, animals burrow, and people dig new pits during subsequent occupational episodes. It also happens at open-air sites, however. A widely known example is the barley (*Hordeum vulgare* L.) from Wadi Kubbaniya, Egypt, dated by stratigraphic association to 17,000 b.p., but determined by direct AMS radiocarbon dating to be only 5000 years old (Wendorf et al., 1979; Wendorf et al., 1984). The early dates were big news. The later ones were made available to the scientific community, but were not, to my knowledge, picked up by the press.

REVISING THE CHRONOLOGY FOR MAIZE DOMESTICATION IN MESOAMERICA

The most sacred scheme for agricultural origins undermined by AMS radiocarbon dating is the sequence in the Tehuacán Valley of Puebla, Mexico. Maize (*Zea mays* L. subsp. *mays*) cobs from levels in which some material was as old as 5000 B.C. form the backbone of competing theories for the domestication of this, the most important food plant of millions of native Americans for millennia (Benz & Iltis, 1990; Doebley, 1990; Galinat, 1985; Mangelsdorf, 1974). None of the original radiocarbon samples from these sites included actual maize material, because the specimens were too small and much too valuable to be sacrificed.

Recently, AMS radiocarbon dates were acquired using tiny pieces of 12 maize specimens from three of the Tehuacán Valley rockshelters: Cueva San Marcos, Cueva Coxcatlán, and Cueva Purrón (Long et al., 1989). Richard MacNeish, the original excavator, selected the 12 samples that he considered to have the "best proveniences and relationships to well-dated levels" (Long et al., 1989: 1036). Eleven samples came from levels assigned to the Coxcatlán Phase (3500–5000 B.C.) and one from the Abejas Phase (2500–3500 B.C.). To make a long story short, all of the cobs thought to be 5500–7000 years old (3500–5000 B.C.) were determined to be significantly more recent (Table 1). The oldest midpoint date (before dendrocalibration) is 2750 B.C.; the youngest specimen turned out to be only 500 years old (450 b.p. ± 40: A.D. 1500). Three other cobs were assayed as falling within the past 2000 years: A.D. 50, A.D. 90, and A.D. 390. The rest fall within the second and third millennia B.C., not the fourth, fifth, or sixth millennia as published in hundreds of books and articles (e.g., Fagan, 1994: 302; Fiedel, 1992: 181; Jennings, 1989: 258).

The authors of the report for the journal *Radiocarbon* (Long et al., 1989) soften the blow of these dates by using the one-sigma calendric date ranges after calibration. This pushes four of the cobs back into the fourth millennium B.C., and makes it possible to envision the earliest specimen as going back to 3640 B.C. If the original dates, those based on associated charcoal, were viewed as dendrocalibrated, one-sigma ranges, however, they too would be pushed back more than 1000 years, so the discrepancy remains a major one.

The consequences for both archaeologists and botanists go beyond teaching us to have greater respect for post-depositional processes that result in the mixing up of sediments and artifacts of various ages. Maize may not have been domesticated until approximately 3500 B.C. The search for earlier evidence is ongoing, but if domestication had occurred as early as once believed, why would the earliest dated maize in the Tehuacán rockshelters, now accepted as fully domesticated (Benz & Iltis, 1990), be so primitive-looking that Mangelsdorf et al. (1967b) argued that it was wild and others described it as transitional between wild teosinte and domesticated maize (cf. Benz & Iltis, 1990)?

I must assume for now that all of the undated cultigens from Tehuacán (Mangelsdorf et al., 1967b; Smith, 1967), Tamaulipas (MacNeish, 1958; Whitaker et al., 1957), and Oaxaca (Flannery, 1986; Whitaker & Cutler, 1971) are intrusive into the earlier strata in which excavators found them. This means we have no documentation for 9000-year-old *Lagenaria siceraria* (Mol.) Standley or *Cucurbita pepo* L.—nor even 7000-year-old cucurbits—no Mesoamerican agriculture until after 4000 B.C. Early food production in Mexico, then, would have begun thousands of years later than in the Old World, where cereal domestication is well documented by 8000 B.C. (Bar Yosef & Belfer-Cohen, 1992). It becomes necessary to re-evaluate models in the New World that rely on early Holocene rather than middle Holocene climatic variables, to reconsider population growth as a condition preceding plant domestication, and to drastically shorten the time interval between incipient agriculture and maize-based village societies.

PREAGRICULTURAL SEDENTISM IN THE BASIN OF MEXICO

Archaeologists working in the southern part of the Basin of Mexico suggested some years ago that sedentary preagricultural societies developed there as early as 6000 B.C. Abundant plant remains were found at the Zohapilco site, including grains of teosinte, which was then classified as *Zea mexicana* (Schrader) Kuntze. Mammals, turtles, fish, and lake birds were evidently easily and frequently procured. Early agricultural strategies appear here after 3000 B.C., with crops including *Amaranthus hypochondriacus* L., *Physalis* sp., and *Capsicum* sp. No charred maize was reported, but *Zea* pollen was larger and three times more abundant in strata postdating 3000 B.C. than it had been earlier (Niederberger, 1979: 137).

Christine Niederberger reported these finds in the journal *Science* in 1979, stressing the difference between the developmental sequence in the Basin of Mexico and the ones reported from Tehuacán and Oaxaca. The Tehuacán model—taught as gospel to two generations of archaeologists and still in 1993 popular among textbook authors and professors—has key plant species domesticated earlier, but sedentary settlements not occurring until after 2000 B.C. Niederberger (1979: 140) wrote:

> . . . in the lacustrine environment of the temperate highlands . . . and probably in some estuarine zones of coastal Middle America as well, it would seem that this [Tehuacán] scheme of socioeconomic evolution in Post-Pleistocene times, from semi-nomadic mainly gathering groups to sedentary fully agrarian societies, is not applicable. Artifactual and nonartifactual evidence from the lacustrine shores of the Chalco Basin already suggest the existence of fully sedentary human communities in this region from at least the sixth millennium B.C.

Consequences of an early sedentary economy include preagricultural territorialism, a higher rate of population growth, increased manipulation of useful plants, and "a more integrated sociopolitical organization" (Niederberger, 1979: 141).

In addition to making the dominant model for agricultural origins in the New World much less plausible, a shifting forward in time of the sequence of maize domestication in Mexico also shortens the interval between the earliest Mesoamerican farmers and their counterparts in the Greater Southwest and in eastern North America. It is to people living north-of-the-border that I turn next.

I ignore arguments that maize and other cultigens were present in South America much earlier than the directly dated Tehuacán maize cobs (Pearsall, 1992). Unfortunately, all available South American evidence is either in the form of rockshelter plant remains dated only by stratigraphic association and quite possibly intrusive, as at Tehuacán, or pollen, or phytolith evidence. No direct dates on cultigens are currently available and until they are produced, I must take the conservative view that an early South American sequence is unsubstantiated.

EARLY AGRICULTURE IN THE U.S. SOUTHWEST

Some of the earliest radiocarbon samples to be processed in Libby's lab at Chicago came from Bat Cave in western New Mexico (Arnold & Libby, 1950; Dick, 1965; Libby, 1951; Mangelsdorf et al., 1967a). Dates on wood charcoal, together with morphological characteristics of the cobs in comparison with maize from Tehuacán, constituted the basis for the long-held tenet that maize agriculture had diffused into the Southwest from Mesoamerica before 2000 B.C. (Haury, 1962; Jennings, 1974; Woodbury & Zubrow, 1979). The original Bat Cave cobs were treated with a lacquer that contaminated them for radiocarbon dating (Wills, 1988: 126), but archaeologists from the University of Michigan returned to Bat Cave in the 1980s for further excavations. Direct AMS radiocarbon dates on newly excavated maize and squash established the presence of both cultigens in the Southwest by approximately 1000 B.C. rather than 2000–2500 B.C. Directly dated plant remains from at least five other Southwestern sites are nearly as old as or slightly older than their counterparts at Bat Cave (Wills, 1992: 154). Considering one-sigma date ranges after calibration, Wills (1992: 153) suggested that 1200–1500 B.C. is a convenient time estimate for the earliest farming in this region.

Most Southwestern archaeologists think native Archaic hunter-gatherers adopted cultigens that had been passed from group to group across northwest Mexico (Minnis, 1985, 1992; Willis, 1988, 1992), but some see evidence for migration of farming families into the region (Berry, 1985; Huckell, 1990). Those who doubt actual migration of people disagree about the initial impact of cultigens and the degree of commitment to early agricultural pursuits.

Recent excavations and paleoethnobotanical analyses in the Tucson Basin of Arizona have resulted in the hypothesis that preagricultural societies with access to dependable water sources in high diversity zones of the Sonoran Desert were largely sedentary (Fish et al., 1990). Settlement patterning and architecture during the early agricultural first millennium B.C. seem little different from those of the preceding period. Mesquite beans (*Prosopis* spp.) were probably staple foods before and after the introduction of maize, along with cactus fruits and seedy annuals. This pattern is not altered until many centuries after the development of Hohokam culture, with its fine pottery and irrigation systems. The archaeologists who directed this research proposed (Fish et al., 1990: 77):

> Seasonally mobile bands cannot be assumed to represent the only possible precursor groups to early cultivators in arid and semi-arid portions of North America. . . . Where . . . environmental constellations were optimal, residential stability could have been possible to a degree that cultivation did not entail substantial alteration of seasonal schedules.

So far, then, the earliest evidence for maize agriculture has been pushed forward in time toward the present by approximately 2000 years in Mesoamerica and nearly 1000 years in the Southwest. In both of these regions, sedentary groups exploiting rich biological zones may have been the first farmers, not the nomadic foragers of classic scenarios. Stratigraphic associations have proven untrustworthy, especially in rockshelter sites. I emphasize this information because the old schemes—especially the "7000-year-old" maize from Tehuacán and belief in even older cucurbits from Oaxaca—are so widespread and so slow to be edited out of textbooks. The way things stand right now is also temporary, of course. New evidence will turn up, and some of it might be very old. It must, however, be directly dated.

Eastern North America: Independent Center of Plant Domestication

Eastern North American prehistory has also been altered by AMS radiocarbon dating, and here, as elsewhere, the timing of agricultural origins has been affected. In spite of little direct evidence in the form of actual plant remains, the 1000 B.C. boundary between the Late Archaic and Early Woodland periods used to be a convenient date for the beginnings of maize agriculture in the East (Fagan, 1974; Willey, 1966). Most societies in the region, however, seemed unaffected by the transition to maize farming that was allegedly occurring in some river valleys during the first millennium B.C. Moreover, the importance of introduced cultigens in the diets of people who were ostensibly growing them was hotly debated. A major complication in this region since the 1920s (Gilmore, 1931; Harrington, 1924; Jones, 1936; Linton, 1924) has been the ubiquity of native seed types, some present in earlier contexts than maize and having a "cultivated" look about them.

Direct dating of maize fragments invalidated specimens thought to go back as far as 800 B.C., but it has validated tiny fragments from several sites, giving us a current estimate of 100 B.C. for introduction of corn into the East (Conard et al., 1984; Chapman & Crites, 1987; Fritz, 1993). Native seed plants were being domesticated 2000 years earlier (Table 2), as demonstrated by direct dates on larger-than-wild sunflower (*Helianthus annuus* var. *macrocarpus* (D.C.) Cockerell) and sumpweed (*Iva annua* var. *macrocarpa* (Blake) Jackson) achenes (Asch & Asch, 1985; Conard et al., 1984; Crites, 1993). *Chenopodium berlandieri* Moq. subsp. *jonesianum* Smith was domesticated before 1000 B.C. (Smith & Cowan, 1987), with local sequences supporting the inference that this crop was part of an indigenous, temperate gardening complex and not an import from Mesoamerica (Fritz, 1990; Fritz & Smith, 1988; Smith, 1989). *Polygonum erectum* L., *Phalaris caroliniana* Walter, and *Hordeum pusillum* Nuttall were incorporated into eastern farming systems by the early first millennium A.D., and, although these fruits lack striking morphological characters to distinguish them from wild counterparts, their frequencies, contexts, and associations mark them as part of the early seed cropping complex (Fritz, 1990, 1993; Johannessen, 1988; Watson, 1989).

The presence of *Cucurbita* cf. *pepo* rind in 7000-year-old deposits in Illinois (these were directly AMS radiocarbon-dated and reported by Conard et al., 1984) stole some of the thunder from the early native cultigens because squash was viewed as a tropical cultigen and, as such, would pre-date and possibly serve as a source of inspiration for indigenous seed cultivation north-of-the-border. We now have an alternative scenario to that involving diffusion northward of early domesticated pepo squashes. Two subspecies of *C. pepo* have been recognized on the basis of allozyme frequencies (Decker, 1988), and these groups are validated by chloroplast DNA research (Wilson et al., 1992). One group, designated *C. pepo* subsp. *ovifera* (L.) Decker (Decker, 1988), includes the squashes and gourds typically grown by prehistoric eastern North American Indians and may well have been domesticated in this region (Heiser, 1989; Smith et al., 1992). The 7000-year-old rind from Illinois probably reflects harvesting of wild or ruderal native gourds. By 2300 B.C., however, *Cucurbita pepo* seeds from the Phillips Spring site in western Missouri had increased slightly in size (King, 1985), and by 1100 B.C. pepo seeds from the Marble Bluff site in northwestern Arkansas were clearly from domesticates (Fritz, 1986). Dates for early domesticated *C. pepo* subsp. *ovifera* fall within the range acquired for domesticated sunflower, sumpweed, and chenopod (2500–1000 B.C.), so there is no longer a necessity to import any tropical cultigen from Mesoamerica as a stimulus or model for eastern North American seed cultivation.

Eastern North America now holds the status of an independent center of plant domestication (Smith, 1989). Cultigens were present here slightly before they have been detected in the U.S. Southwest, and the Southwestern crops diffused from Mesoamerica, whereas the eastern ones were domesticated locally. Some Early Woodland groups were more sedentary and arguably more dependent upon crops during the first millennium B.C. than were their Southwestern contemporaries, in spite of the fact that maize was not being grown yet in the East.

TABLE 2. Chronology of prehistoric food production in the eastern U.S.

Post-A.D. 1200	Starchy seeds decline; maize, beans, squash dominate
A.D. 900–1200	Maize established as staple
A.D. 1000	Common bean (*Phaseolus vulgaris* L.) Grain Amaranth (*Amaranthus hypochondriacus* L.) Cushaw squash (*Cucurbita argyrosperma* L. H. Bailey subsp. *argyrosperma*)
A.D. 500	Pale-fruited chenopod (probably *Chenopodium berlandieri* Moq. subsp. *jonesianum* Smith)
A.D. 100	Tobacco (*Nicotiana ?rustica* L.)
100 B.C.	Earliest known maize (*Zea mays* L. subsp. *mays*)
300 B.C.–A.D. 1000	Heavy starchy seed use: *Chenopodium berlandieri* subsp. *jonesianum*, *Phalaris caroliniana* Walter, *Polygonum erectum* L., *Hordeum pusillum* Nuttall
1500 B.C.	Thin-testa chenopod (*Chenopodium berlandieri* subsp. *jonesianum*)
2300 B.C.	Domesticated pepo gourd/squash (*Cucurbita pepo* subsp. *ovifera* (L.) Decker var. *ovifera*)
2300 B.C.	Domesticated sunflower (*Helianthus annuus* var. *macrocarpus* (D.C.) Cockerell) and sumpweed (*Iva annua* var. *macrocarpa* (Blake) Jackson)
5000 B.C.	Use of wild(?) gourds (*Cucurbita pepo* L. subsp. *ovifera* and *Lagenaria siceraria* (Mol.) Standley)

After maize was introduced, at about the time of Christ, it remained a minor crop for between 600 and 1200 years, depending upon the subregion. In some places, including the Greater St. Louis area, intensification of maize agriculture was accompanied by intensification of the native seed crops (Lopinot, 1991). The farmers at Cahokia, Illinois, and surrounding sites began growing more chenopod, maygrass, and erect knotweed between A.D. 800 and 1100, along with greater quantities of maize. It was not until the last few centuries before European contact that the native seeds declined and the trinity of corn, beans, and squash dominated most fields in what is now the eastern United States.

As in both Mesoamerica and the U.S. Southwest, the earliest maize in eastern North America is not as early as once believed. In some parts of the East, however, the chronology for pre-maize ag-

TABLE 3. Comparison of agricultural chronologies in Mexico, the Southwest, and eastern North America.

	Mexico	Greater Southwest	Eastern U.S.
A.D. 1600			
A.D. 1000			Maize farming villages
0		Maize farming villages	Earliest dated maize
1000 B.C.	Maize farming villages	Earliest dated maize and squash	Pre-maize farming societies
2000 B.C.			Earliest native cultigens
3000 B..C	Earliest dated maize		
4000 B.C.			
5000 B.C.	Undated maize		
6000 B.C.			
7000 B.C.	Undated cucurbits		

riculture has been pushed back to make it the earliest food production north of Mexico. If we disregard for now all undated and arguably intrusive cultigens in early rockshelter strata in Mexico, and hence use 3500 B.C. as the approximate age of initial plant domestication in Mesoamerica, then the first native eastern North American farmers appear downright precocious (Table 3).

This may, of course, be an artifact of the current state of research. Eastern North American archaeologists have conducted more intensive flotation for recovery of small seeds and other charred plant materials, and it has been easier for us to acquire funds and permission to date relevant samples than has been the case elsewhere. Studies into the domestication of grain amaranths and chenopods are underway in Mexico (McClung de Tapía, 1992), and these hold promise for expanding the Mesoamerican sequence. Still, I repeat, we cannot cling to notions from the past that have been severely undermined, particularly the notion that good evidence exists for Mesoamerican agriculture at 5000 B.C. or earlier.

PERSISTENCE OF WILD RESOURCE HARVESTING IN THE LOWER MISSISSIPPI VALLEY

My own primary research territory for the past four years has been east central Louisiana, particularly Tensas Parish, which, along with the lower Yazoo River basin in Mississippi, is the heartland of Coles Creek Culture. The Early Coles Creek period begins at A.D. 700 (Table 4), with well-made ceramics and regional mound centers distributed across the ridge-and-swale topography of the bottomland zone between the Tensas and Mississippi rivers. Coles Creek mounds served primarily as platforms for specialized structures or activities, probably of a ritual nature. They have been interpreted as early signatures of hierarchically ranked societies of the sort anthropologists call chiefdoms (Fritz & Kidder, 1993; Kidder, 1992; Steponaitis, 1986). These were by no means the earliest mound builders in the Lower Mississippi Valley, but Coles Creek sites are relatively early for platform mounds oriented around central plazas, which is the typical pattern for complex Mississippian cultures. "Mississippian" is the label for the agricultural chiefdoms that arose in eastern North America just before A.D. 1000 and persisted until the European invasion. Because maize was the foundation for Mississippian subsistence elsewhere, it has long been assumed that, from the beginning, Coles Creek people practiced maize agriculture. When the importance of pre-maize farming in the Midwest became recognized, attention turned to the Lower Mississippi Valley as a possible cradle for the domestication of native seed crops (Cowan, 1985: 242; Ford, 1985: 349).

My colleague T. R. Kidder and I implemented flotation recovery at the Osceola mound site in 1989, speculating that native seed cropping would be more important than maize production during the early Coles Creek period (before approximately

TABLE 4. Subsistence change in the Lower Mississippi Valley.

Culture	Time	Major plant foods	Other plant foods
	A.D. 1730		
Natchez		Maize, squash, pumpkins, beans, fleshy fruits	Seeds of native annuals; Old World crops
	A.D. 1600		
	A.D. 1500		
Plaquemine		Maize, acorns, fleshy fruits, tubers (?)	Pecans, hickory nuts, squash/gourd, seeds
	A.D. 1200		
Late Coles Creek		Acorns, fleshy fruits, tubers (?)	Maize, pecans, seeds
	A.D. 900		
Early Coles Creek		Acorns, fleshy fruits, tubers (?)	Seeds, pecans
	A.D. 700		
Troyville		Acorns, fleshy fruits	Seeds, pecans
	A.D. 400		

A.D. 900). What we found, however, were indications of intensified management of wild resources—primarily acorns (*Quercus* spp.), fruits (*Diospyros virginiana* L., *Vitis* spp., *Rubus* spp., *Sabal minor* (Jacq.) Pers.), fish, turtles, and deer—along with evidence for tubers and some harvesting of seeds, but not of domesticated native crops (Table 4). Squash rind is present, presumably *C. pepo* subsp. *ovifera*, but the tiny pieces cannot be distinguished as domesticated rather than wild. My guess is that they were crops, but that their cultivation was casual and their food value secondary to technological use as vessels and possibly net floats.

Test excavations at a slightly earlier site near Osceola, combined with subsistence remains from much earlier components reported by other archaeologists, dating as far back as 1000 B.C., show that the Lower Mississippi Valley was not the early agricultural center once believed (Jackson, 1989; Kidder & Fritz, 1993). It was instead a rich region where hunter-gatherers developed the technology for sustaining relatively dense, sedentary populations controlled and integrated by complex social mechanisms. By Coles Creek times, people had probably relinquished the strong ethic of food sharing called "balanced reciprocity." They were less committed to egalitarian principles than before and concerned to some degree with the relative status of their kin groups. Clans or lineages may have had restricted ownership of fishing and acorn harvesting territories. Kinship groups may have been responsible for building and maintaining fish weirs and for thinning and burning orchard-like oak groves.

I think the mound centers were places where communities came together for ritually regulated occasions. Feasts held at these times would display the wealth of the hosts and conceivably also the guests, if they were expected to bring food or other goods. A competitive spirit to the festivities would stimulate surplus production. Distribution of surpluses would even out imbalances caused by localized fluctuations and, at the same time, create obligations that indebted groups would be anxious to pay off as soon as possible by hosting their own events.

The religious and political leaders must have coordinated this type of system, but the presence of high status individuals in Coles Creek society is obscure. Most Coles Creek burials in any given cemetery are much like all the others, with few individuals distinguished by associations with special artifacts or other types of burial arrangements (Kidder, 1992). I infer that the concern with differential status was more on a lineage- or kinship-based community level, and that individual leaders, especially prior to A.D. 1000, were either not interested in or not capable of using their positions to amass personal wealth and power. In short, differential status existed in these societies, but they had not become hierarchically stratified to the extent of Southeastern chiefdoms encountered by De Soto and other European explorers of the 16th century.

Chiefdoms had arisen no later than the 11th century A.D. in the central Mississippi River valley and across the South (Barker & Pauketat, 1992; Steponaitis, 1986). Insignias of chiefly office and other high status indicators accompany burials in many early second millennium sites surrounding the Lower Mississippi Valley. Maize is usually well represented in middens, pits, and structures at these sites (Scarry, 1993), and stable carbon isotope studies on human bone usually indicate a significant amount of maize in the diet (Buikstra & Milner, 1991).

The most elaborate expression of chiefly authority is found just across the Mississippi River to the east of St. Louis, at the great site of Cahokia. More than 100 mounds were constructed at that site. The largest, called Monks Mound, stands 33 m in height. Burials in Mound 72 show the lavishness with which chiefs were interred. Grave goods include thousand of beads made of marine shell from the Gulf of Mexico or Atlantic Ocean, rolls of sheet copper from Lake Superior, mica from the Appalachian Mountains, and arrow points of various non-local cherts (Fowler, 1975). People living at Cahokia grew a great deal of maize, but crop diversity was high, and maygrass, chenopod, erect knotweed, and other native grains were more than minor supplements (Johannessen, 1988; Lopinot, 1991).

Late Coles Creek culture (A.D. 900–1200) in the Lower Mississippi Valley was affected by these developments, but persisted in established traditions for the most part. Mound centers are larger, however, indicating increased status differentiation and, possibly, consolidation of authority and responsibility by individual leaders. Our work in Tensas Parish demonstrates that maize was present between A.D. 900 and 1200, but in frequencies too low to allow an inference of large-scale agriculture. Instead, Late Coles Creek people continued to fish, hunt, and harvest wild plant foods for their primary sustenance (Fritz & Kidder, 1993).

Coles Creek culture evolved into what archaeologists call Plaquemine, with a chronological boundary at A.D. 1200. We tested a single-component Plaquemine locale named the Emerson site, which dates to approximately A.D. 1450, in order to determine whether or not agricultural intensification could be observed. We found maize fragments in abundance in the middens at Emerson: 27 times more maize per liter of soil floated than at Osceola. The relative abundance of Plaquemine maize strengthens our belief in minimal use of maize by Coles Creek people. Heavy use of acorns and wild fruits continued into late prehistoric times, but Plaquemine farmers did not incorporate native seed crops such as *Iva annua* var. *macrocarpa* or *Chenopodium berlandieri* subsp. *jonesianum* into their food production systems.

WHY DID COLES CREEK HUNTER-GATHERERS BECOME PLAQUEMINE FARMERS?

We went to Tensas Parish thinking we might find early agriculturalists growing either maize or native starchy seed crops. Instead, we found socially complex fisher-gatherer-hunters persisting in their harvesting of wild resources in spite of the fact that people around them, and presumably well known to them, were adopting or intensifying maize agriculture. Farming came late to Tensas Parish, not being intensified until at least A.D. 1200. The big question for anthropologists, still largely unanswered is: Why did hunter-gatherers switch to farming? In this case, why would they begin the arduous task of clearing levees and any other deposits of non-clayey soil, and worrying about crops sensitive to floods, droughts, insect pests, and raids by deer or other marauders?

Anthropologists of the 1990s are more interested in the role of social relations for stimulating this type of transition and less satisfied with the ecologically or demographically causal explanations that were popular during the past few decades (Barker & Pauketat, 1992; Nassaney & Cobb, 1991). Within the realm of social relations, Southeastern archaeologists are especially intrigued with high status individuals and the decisions they may have made to encourage agricultural production. Early chiefly elites in Tensas Parish would have been responsible for hosting and negotiating with their counterparts across the Late Coles Creek region and for dealing with the already more stratified Mississippian chiefs. Details of the prehistoric decision-making process will never be known, but one plausible scenario is that maize was first used primarily as a ritual offering or foodstuff at special occasions (Fritz & Kidder, 1993; Rose et al., 1991; Scarry, 1993). The more maize a community could provide at a feast, the more leverage its leaders would have in negotiating with chiefs of expansionary Mississippian polities whose civic centers had granaries full of maize.

Another plausible social mechanism, not mutually exclusive with the above, involves intermarriage between the Coles Creek hunter-gatherers and their Mississippian neighbors. Women farmers entering a village of acorn harvesters would want to feed themselves and their children the proper way—i.e., the way they themselves had been raised—so would initiate maize cultivation. If this type of marriage initially occurred at the elite level as a political strategy, maize production would be seen as prestigious and would more likely be emulated. Because North American Indian men did little if any farming anywhere in the Eastern Woodlands, the transmission of agricultural expertise was probably from woman to woman.

Complex Hunter-Gatherers

One of the key points of this paper is that Coles Creek people, like people in the Basin of Mexico before 3500 B.C. and groups in the Tucson Basin at 2000 B.C., were sėdentary hunter-gatherers on the eve of their adoption of agriculture. They maintained relatively high population densities, marked their territories with mound-dominated ceremonial centers and cemeteries, and were internally differentiated by ranked social positions. Appreciation of complexity in hunter-gatherer societies in general is growing, and most information comes from the archaeological record and from archival sources (Bar-Yosef & Belfer-Cohen, 1992; Gebauer & Price, 1992; Henry, 1985; Marquardt, 1992; Price & Brown, 1985). Some of these societies—the Natufians of the ancient Levant, for example—probably deserve credit for primary plant and animal domestication, and others were the earliest to adopt agricultural practices when exposed to them by neighbors. The transition to agriculture was not always immediate or large scale, and not necessarily an economic improvement. The sedentary hunter-gatherer lifeway persisted for millennia in several resource-rich zones even after cultigens were present in nearby regions and almost certainly available through exchange.

Classic examples of complex hunter-gatherers who flourished in North America until they were killed off or subjugated by Europeans are the Calusa in southwest Florida and the many diverse native groups of California and the coastal Pacific Northwest. All of these groups had access to abundant aquatic resources as well as to wild plant carbohydrates. The Californians harvested acorns from well-tended groves, storing and consuming great quantities of acorn meal (Jackson, 1992; Kroeber, 1976). All of these groups possessed knowledge of plant husbandry, and all probably grew tobacco for ritual purposes. Even the existence of special-purpose gardens, however, does not alter the classification of these groups as complex hunter-gatherers.

Calusa society was destroyed before 1800 by disease and social disruption brought about by Spanish missions and American colonial expansion, and most native Californians had either died, accepted mission life, or moved away from their home villages by the 1830s. In spite of rapid alteration by epidemic disease and enforced missionization, abundant evidence exists for strict social regulation in these societies (Arnold, 1992; Hann, 1991; Kehoe, 1992; King, 1978). They were not like the stereotypical Plains Indian bands in the Wild West during the late 19th century, where a person's status was achieved primarily through deeds and exploits. Chiefs along the West Coast were born into their high status positions and had great authority and responsibility. In California, status at birth determined whether one would be a boat owner, doctor, dancer, craft specialist, or mere commoner. Accumulation of wealth was a major concern, a form of shell currency was exchanged, and slave ownership was practiced until Canadian and U.S. laws made it illegal (Kehoe, 1992). Indian people of the Northwest Coast today still appreciate the ancestral social hierarchy (Blackman, 1982).

Competition existed between groups, and violent conflicts were not unusual, but a great deal of cooperative interaction took place in the form of trade and feasting. Sea transportation was carried out in boats made of redwood planks, in tule reed rafts, or dugout canoes (Ames, 1985; Arnold, 1992; Kehoe, 1992). Although group territories were restricted, the active exchange networks made it possible to distribute marine resources from offshore, shellfish from the coast, salmon from upstream spawning grounds, acorns and seeds from interior valleys, and other foods from various ecological zones. I believe that strong social regulation within and between political units was necessary for maintenance of high population densities, even in an environment as diverse as California.

Prehistoric population sizes are notoriously difficult to calculate, and published estimates diverge widely. The most reliable recent reconstruction is, in my opinion, that of Douglas Ubelaker (1988) of the Smithsonian Institution's Department of Anthropology. Ubelaker made tribe-by-tribe estimations of North American Indian populations at the time of European contact based on information compiled by regional experts for the Smithsonian's recent *Handbook of North American Indians.* California and the Pacific Northwest ranked first and second in population density, with an estimate of 75 people per 100 km^2 in California and 54 people per 100 km^2 along the Northwest Coast

TABLE 5. Estimates of North American population size and density at first European contact (from Ubelaker, 1988).

Area	Population	Population per 100 km^2
California	221,000	75
NW coast	175,330	54
Southwest	454,200	28
Southeast	204,400	22
Northeast	357,700	19
Columbia Plateau	77,950	15
Plains	189,100	6
Great Basin	37,500	4
Arctic	73,770	3
Sub-arctic	103,400	2

Total population = 1,894,350. Average population per 100 km^2 = 11.

(Table 5). The third and fourth most densely populated regions were the Southwest and Southeast, with an average of 28 and 22 people per 100 km^2, respectively. The complex hunter-gatherers of the West Coast were, according to these estimates, extremely successful at extracting the resources available to them. There is little cause for wondering why they failed to plant more crops even though they had access to them and understood the concept of cultivation.

CAN WE LEARN FROM THE PAST?

Two years ago I met with Alwyn Gentry, who was hoping that the "ethnobotanical" part of my paleoethnobotanical research might be of some value in his conservation efforts. After telling him about such things as domestication of *Chenopodium berlandieri* subsp. *jonesianum* and intensification of native starchy seed crops along with maize in eastern North America, he smiled and said, "You're no help." His death and the consequent premature truncation of his contributions challenge me to search harder for relevance in the study of ancient plant use. The insights I offer do not rival the importance of finding cures for diseases or salvaging information from threatened rainforests. Archaeological data can, however, be used to strengthen arguments for sustainable harvesting of forest products, and can serve as alternative models to low diversity agricultural systems.

In several parts of the world, the achievements of complex hunter-gatherers of the far and not-so-far distant past highlight the feasibility and potential stability of nonagricultural systems. These societies were not mobile, egalitarian bands like the !Kung San of the Kalahari Desert (Lee & DeVore, 1968). They were sedentary and territorial, practiced food storage, engaged in widespread trade, and allowed their leaders to have special privileges and to pass these on to their children. The duration of nonagricultural complexity was not always brief, and it did not inevitably evolve into full-blown farming given the first window of opportunity. Local vegetation was undoubtedly altered by these societies, but not necessarily in an adverse or irreversible way.

The most significant aspect of a shortened history of domestication in the New World, as I interpret the recent AMS radiocarbon dates, is that it adds at least two millennia to the era preceding maize or other food crops. It turns attention away from the semiarid valleys of Tamaulipas, Puebla, and Oaxaca, where nomadic bands made seasonal rounds for thousands of years, and directs attention to more optimal zones where aquatic resources and surrounding vegetation enabled people to settle more densely. In the absence of directly dated early cultigens from rockshelter sites, the Basin of Mexico scenario acquires wider appeal.

In Mesoamerica, as elsewhere, complex hunter-gatherers may have flourished for some time (between 6000 and 3500 B.C.) and themselves engaged in primary plant domestication and subsequent intensification (between 3500 and 2000 B.C.). Farming villagers who made pottery and relied on cultigens for most of their sustenance dominated the scene by 1500 B.C. (McClung de Tapía, 1992), after a shorter transitional period than previously believed.

In Louisiana, also, the early Coles Creek mound builders and their ancestors were nonagriculturalists practicing sustainable harvesting of the rich inland Mississippi River delta. Adoption of maize came later than previously believed, and it may have been required or encouraged by elite individuals as a result of interactions with neighboring farmers. North American Indians along the West Coast and in southwest Florida did not become farmers until after European contact, and the archaeological record in these areas shows long sequences of in situ harvesting of wild plant and animal foods and early growth of social mechanisms to control sedentary life (Ames, 1985; Arnold, 1992; Marquardt, 1986, 1992).

North American Indians before 1492 did not have to cope with threats from greedy and even more complex imperialist nations or multinational corporations capable of stripping forests and orchards, polluting the waters, displacing people from their managed landscapes, and substituting a totally different ecosystem. It is impossible, of course, to transpose ancient nonagricultural subsistence economies into today's world. Even for pure research purposes, economic valuation of prehistoric resources would require imaginative quantification. Moreover, evidence for nonsustainability can be inferred even for some ancient hunter-gatherers. Paul Martin's (1984) Pleistocene overkill hypothesis, for example, is cited by Godoy & Bawa (1993) in a recent issue of *Economic Botany* devoted to the subject of sustainable management of non-timber tropical forest products. The Pleistocene overkill hypothesis, however, is considered by anthropologists to be largely disconfirmed (Grayson, 1991). Meltzer (1993: 160) wrote, "It is now clear . . . that Paleoindian hunting was not the prime cause of, and perhaps, did not even contribute to, the terminal Pleistocene extinctions." Even if Paleoindians did play some role in the extinction of Ice Age megafauna, it does not follow that all prehistoric hunter-gatherers inevitably overexploited their environments.

Although resource depletion probably occurred in some times and places, long periods of continuity are evident. Documentable cases of persistence and stability such as the ones discussed above deserve due consideration even if conditions were not static. An appreciation of the social complexity and population densities achieved by these groups makes them seem less remote, less primitive. When seeking solutions to subsistence and conservation problems on the community level, the long archaeological record of sustainable harvesting is a source of information and inspiration.

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